ASSAP Issue # SP6:
Initial
Initial Thoughts on
Dual Link Reception of ADS-B

MITRE/CAASD

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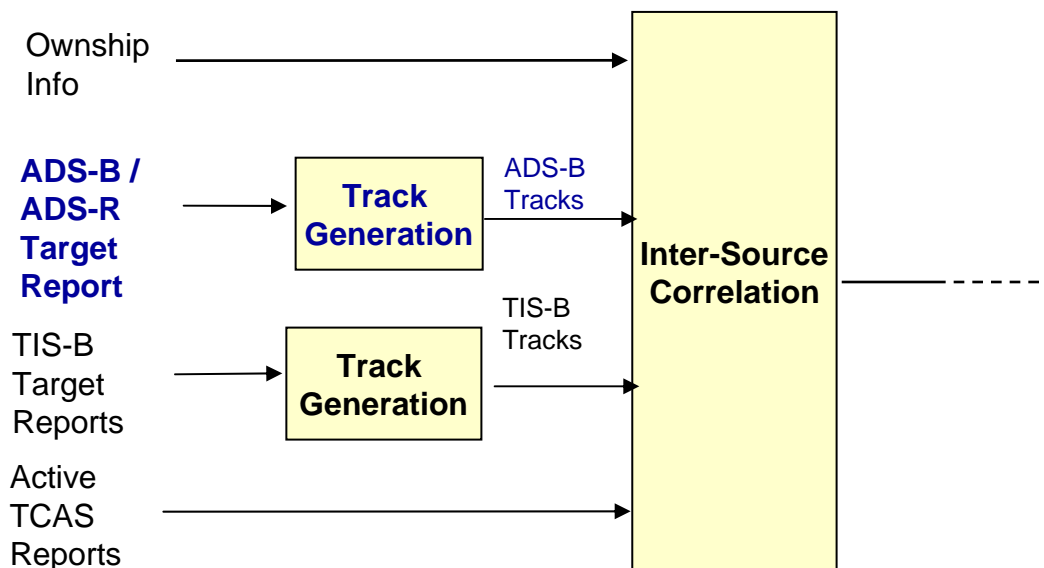*Aug 2006*

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Outline

- **Problem Description**
- **Background Information**
- **Discussion of Alternatives**
- **Assumptions and Conclusions**

Problem Description

- **One proposed function in the strawman ASSAP functional architecture is Source-Level Tracking for ADS-B/ADS-R**
  - **Establish tracks from ADS-B/ADS-R and TIS-B sources separately (Track Generation).**
  - **Note: this is an extension of the statement in the ASA MASPS which did not explicitly call out ADS/R**
    - **Establish tracks from ADS-B and TIS-B traffic reports (Section 2.4.3.4, Page 46).**

Ownship Info →

ADS-B / ADS-R Target Report → **Track Generation** → ADS-B Tracks → **Inter-Source Correlation**

TIS-B Target Reports → **Track Generation** → TIS-B Tracks → **Inter-Source Correlation**

Active TCAS Reports → **Inter-Source Correlation**
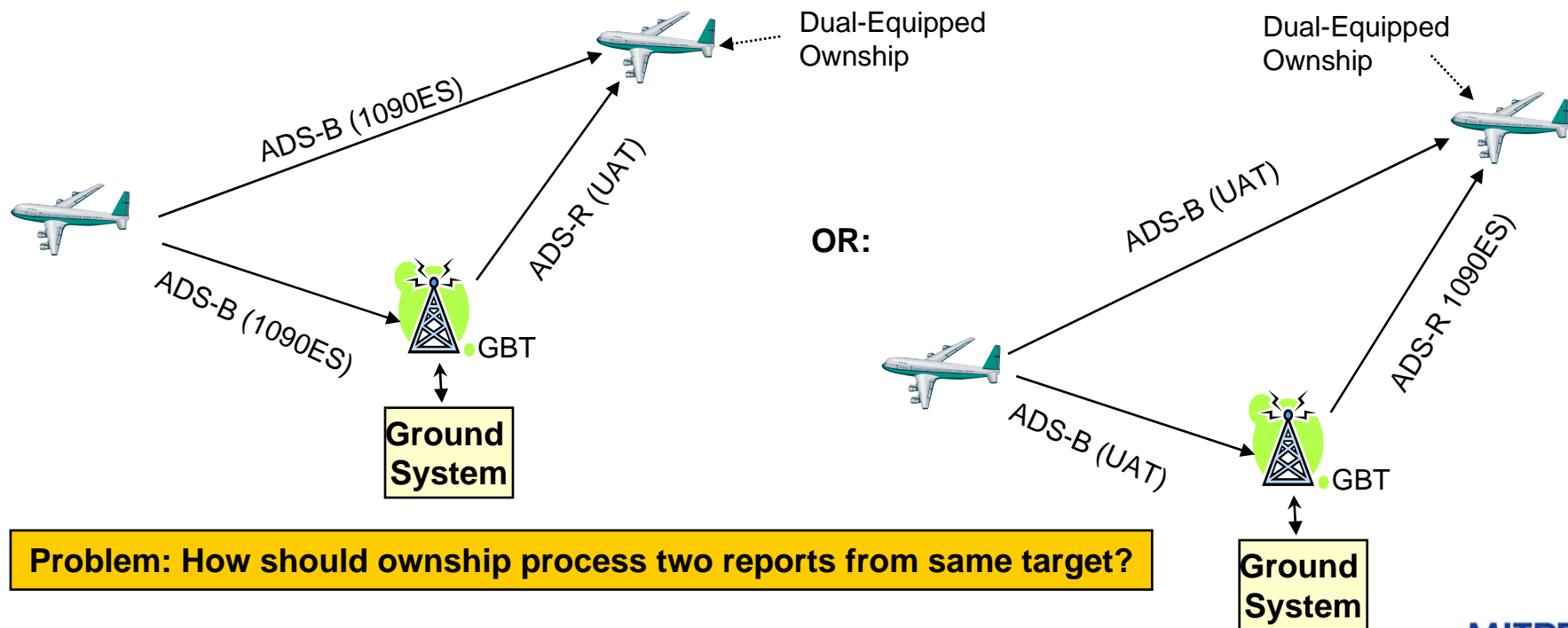
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Problem Description (cont'd)

- **Dual equipped ownship can receive both ADS-B (direct) and ADS-R (rebroadcast) reports on the same target. Consider two alternatives:**
  - **Fusion of ADS-B and ADS-R reports.**
  - **Selection of ADS-B as the primary source and acceptance of ADS-R for track update only when ADS-B reception has ceased for x seconds.**

Illustration of Problem:

Dual-Equipped Ownship

ADS-B (1090ES)

ADS-R (UAT)

ADS-B (1090ES)

GBT

Ground System

OR:

Dual-Equipped Ownship

ADS-B (UAT)

ADS-R 1090ES)

ADS-B (UAT)

GBT

Ground System

Problem: How should ownship process two reports from same target?

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Background Information

- **First, we have establish that ADS-B, TIS-B, ADS-R `services can be distinguished by the receiver subsystem. The following table suggest what information could be used for this distinction. (Verify and complete later.)**

Link Type ⟍ Service Type	UAT		1090ES	
	Address Qualifier	SIL	DF Type	SIL
TIS-B	2 (ICAO ID)	0	DF18, CF2, IMF0 (fine, ICAO) DF18, CF2, IMF1 (fine, Track ID)	0
	3 (Tracker ID)	0	DF18, CF3, IMF0 (coarse, ICAO) DF18, CF3, IMF1 (coarse, Track ID)	0
ADS-R	2 (ICAO ID) ? (Non ICAO) ? (anonymous)	> 0	DF18, CF6, IMF0 (ICAO) DF18, CF1 (non ICAO)? DF18, CF6, IMF1 (anonymous)	> 0
ADS-B	0 (ICAO ID)	> 0	DF17	> 0
	1 (Temporary ID)	> 0	DF1 7	> 0
	4 (Surface)	> 0	DF17	> 0
	5 (Fixed)	> 0	DF17	> 0

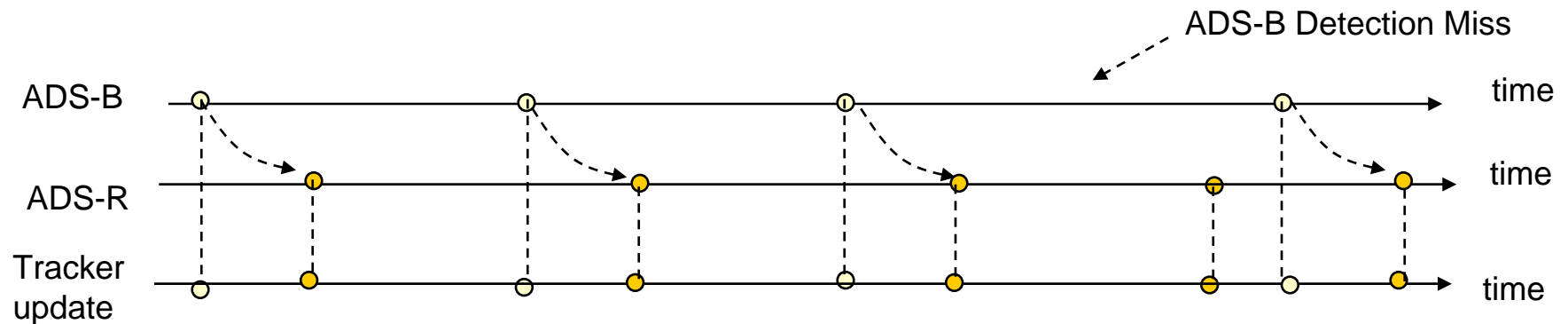**MITRE**

Background Information (cont'd)

- **The ground spec will most likely have ADS-R requirement on:**
  - **Latency**
  - **Compensation for latency in the ADS-R state vector (e.g., the position must be extrapolated to the time of rebroadcast transmission)**

  => ADS-R reports are providing extrapolated position information at the rebroadcast time.
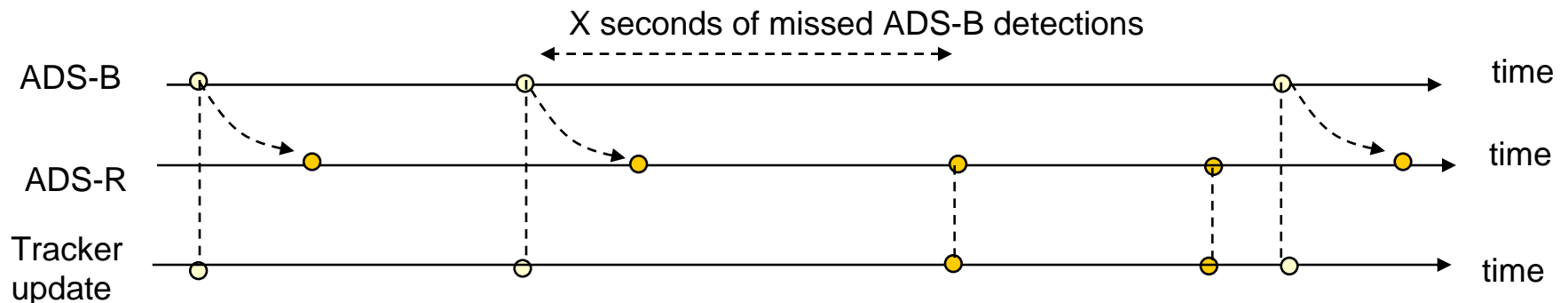
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Discussion of Alternatives

- **Fusion Alternative: Update the ADS-B source level tracker with either ADS-B or ADS-R (that arrives later and is compensated for the latency).**

ADS-B Detection Miss

ADS-B ——————————————————————————————— time

ADS-R ——————————————————————————————— time

Tracker update ——————————————————————— time

- **Source Selection Alternative: Do not update with ADS-R unless ADS-B has not been received for x seconds.**

X seconds of missed ADS-B detections

ADS-B ——————————————————————————————— time

ADS-R ——————————————————————————————— time

Tracker update ——————————————————————— time

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Assumptions and Conclusions

- **Assumption**
  - Both alternatives assume the address in the ADS-R message is not altered from the original ADS-B message (i.e., ADS-B and ADS-R are correlated by their address).
    - Investigate validity of assumption. For example, what happens when the ADS-B address is anonymous in 1090ES and is rebroadcast over UAT
    - If rebroadcast can alter the address, a spatial correlation between ADS-B and ADS-R may be required rather than a simple address matching scheme.

- **Conclusion**
  - Tentatively: dual equipped A/V can operate conflict free. Two alternatives seems viable:
    - Fusion of ADS-B and ADS-R.
    - Selection of ADS-B as the primary source and acceptance of ADS-R for track update only when ADS-B reception has ceased for x seconds.
  - The tradeoff is between processing load and algorithm complexity.

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